

A NOTE ON THE OCCURRENCE AND HABITS OF A
LUMINOUS SQUID (*ABRALIA VERANYI*)
AT MADEIRA.

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Originally made known in very incomplete fashion (vide Rüppell, 1844) from individuals taken in the neighborhood of Messina, our knowledge of this extremely interesting species of squid is based on the information gleaned from the very limited number of specimens which have now and then fallen into the hands of students of the group, principally systematists, since that time. These specimens have been entirely Mediterranean in origin, the majority of them, like the type, from Messina, but a few from Nice, Toulon, and so on. Until quite lately it has happened that almost every captured specimen has found its way into the collections of one or another of the German museums. It has therefore somewhat curiously come about that whereas neither Gray three quarters of a century ago, nor Tryon, nor even Hoyle seem to have had any actual material of the species to work upon, Pfeffer's recourse to the Hamburg and other German collections, especially that at Leipzig, yielded him no less than fifteen specimens (Pfeffer, '12, p. 136). More recently some further specimens, likewise taken at Messina, have been the subject of a short but beautiful memoir by Dr. Silvia Mortara ('22) on the histology of the photophores. Practically the whole of our real knowledge regarding *Abralia veranyi*, from whatever aspect, is to be found in this paper, and in the monograph of Pfeffer, although there is some information to be had from an older paper by Steenstrup ('80) and another by Joubin ('95), where the luminous organs of some specimens from Nice which are probably referable to this species are described under the name *Abralia Oweni*.

It is of interest to remember that of the seven described species of *Abralia*, *A. veranyi* as at present understood is the only

occidental one. One species comes from the Red Sea. The remainder are all Indo-Pacific, two of them being Hawaiian. From the waters of the western hemisphere, even in what would seem entirely appropriate latitudes, the genus is as yet unknown. Thus from the entire Atlantic beyond the gates of the Mediterranean no member of the genus has been reported hitherto.

Furthermore in regard to the behavior of the animal in life or concerning even so much as its appearance at the time of capture I have been able to discover no published information in as nearly an exhaustive search as has been possible to me. What we know or think we know of the natural history of this interesting animal is almost entirely inferential or presumptive.

In view of the situation outlined it is therefore a matter of no small satisfaction to be able to report not alone a considerable and important extension of the known geographic range of this genus and species, but to record a few observations made by the captors of the specimens, which throw a certain light on the habits of the animal, are a welcome contribution after the nearly blank record of the past eighty years, and are themselves withal full of lively interest. For this my acknowledgment is due to the gentlemen to be indicated, as well as to others later mentioned in the course of this paper.

When Professor T. D. A. Cockerell of the University of Colorado returned to the United States from his Madeiran trip in 1921, he brought with him various specimens of invertebrates, among them as by no means the least of the treasures, three small squids. These he generously turned over to me, with the word that they were given him by Senhor A. C. de Noronha of Funchal. The bottle containing them bore the following label in Sr. de Noronha's hand: "Luminous. Caught during the night near the shore rocks. Funchal. June 19, 1917." The three specimens proved to include a beautifully preserved male and two females of the rare Mediterranean enoploteuthid referred to in our preface, *Abralia veranyi*. Through the kindness of Dr. Silvia Mortara I have also been the fortunate recipient of one of her precious Messina specimens, captured in November, 1921. A direct comparison of the Funchal form with authentic Mediterranean material has therefore been made possible.

The principal references covering this species in the literature are given below. Those who desire a more complete synonymy are referred to Pfeffer, '12.

Abralia veranyi (Rüppell, 1844).

(Dates of more important references italicized.)

1844. *Enoploteuthis Verany* Rüppell.—Giorn. Gab. Messina, 26, p. 3, f. 2.
1851. *Enoploteuthis Veranyi* Vérany.—Céph. médit., p. 83, pl. 30, f. b.
1879. *Enoploteuthis Veranyi* Tryon.—Man. Conch. (1), v. 1, p. 173, pl. 76, f. 318-319 (after Vérany).
1880. *Abralia veranii* and *Veranyi* Steenstrup.—Overs. K. D. Vid. Selsk. Forh. 1880, p. 92, 110 [22, 40], pl. 3, f. 2-6.
1886. *Abralia veranyi* Hoyle.—Ceph. Challenger Exp., p. 38, 217 (merely catalogued).
1895. *Abralia Oweni* Joubin.—Mém. Soc. Zoöl. France, v. 8, p. 220 [9], f. 6-11 (photogenic organs).
1899. *Abralia Veranyi* and *Enoploteuthis Verany* "Rüppel" Ficalbi.—Monit. Zoöl. Ital., v. 10, p. 80-82, text f. 2 (after Rüppell).
1900. *Abralia armata* (pars) Pfeffer.—Synops. ægops. Ceph., p. 167.
1900. *Asteroteuthis veranyi* Pfeffer.—Teuthol. Bemerk., p. 289.
1912. *Asteroteuthis Veranyi* Pfeffer.—Monogr. Cægops., p. 129, 785, 794, pl. 16.
1912. *Abralia Veranyi* Pfeffer.—*id.*, p. 785, 794.
1922. *Abralia veranyi* Mortara.—R. Com. Talass. Ital., Mem. 95, p. 1-20, text f. 1-2, pl. (photogenic organs).

A careful comparison of the Madeiran specimens with that from Messina and with the lengthy account given by Pfeffer has brought to light no points of difference thought to be in any respect essential from the taxonomic standpoint. As will be seen from the appended table of measurements, the dimensions of the Madeiran examples are as a rule well in excess of those of the individual from Messina, but this is very decidedly more true of the two females than of the single male and may possibly prove to be, in part at least, a secondary attribute of sex. The wider,

more flaring mantle possessed by all three Madeiran examples is doubtless but an incident of the mechanics of their preservation. The same is doubtless true of the apparent great number of chromatophores resulting in the consequent darker color of these specimens. The greater conspicuousness of the chromatophores seems to carry a concomitant accentuation of the photophores so that at first sight they appear much more numerous than in the Messina specimen. The attempt to count the photophores in corresponding areas, however, has not led to proof of any actual critical difference in their number.

The male indeed does show a few slight differences in the structure of its beautifully preserved hectocotylus, especially in the fact that the tip of the modified arm is so produced and attenuated beyond the curious fleshy folds which are a feature of the distal part of this arm in the present species, and regarding the exact function of which we are still quite in the dark except that there seems good reason to believe that they may serve in some fashion or other in the manipulation and fixation of the spermatophores.

This male and one of the females show but three hooks on each tentacle club. The other female has three hooks and a possible remnant of a more minute proximal one on the left club, while the right club bears four hooks in agreement with both clubs of the Messina specimen. These seem but normal variations. I have noticed no record of any specimens with clubs bearing less than two nor more than four hooks.

A certain degree of sexual dimorphism is, as already noted, indicated by the present specimens, but it is not conspicuous, being chiefly manifested by the somewhat smaller body and fins of the male. The differences noted appear both absolute and relative. The fins are almost equally wide in proportion to mantle length in both males and females, but in the former they are relatively somewhat shorter, giving an index of about 60 as against 66 in the females. The arms of the male on the other hand are somewhat longer in relation to the body than those of the female.

As was discovered by Steenstrup ('80, p. 110), the spermatophores become attached in a rosette-like cluster to the inner

surface of the mantle of the female, this being in the median line just back of the nuchal cartilage. These clusters are very conspicuous in both of the females before me, but there is present in each of them in addition to the principal rosette, a much smaller cluster of 4 to 8 spermatophores or remains of the same adhering to the visceral mass at its mesial junction with the collar, a position not quite opposite to that occupied by the main rosette, but more anterior. Possibly therefore this smaller cluster is to be regarded as a fragment of the larger one, adhering here accidentally at the time of the emplacement of the latter. In both of these specimens the ovaries are swollen and packed with developing ova. Just how soon the ova would be ready for extrusion is at present problematic.

TABLE OF MEASUREMENTS.

| Locality..... | Messina. | Funchal. | | |
|--|----------|----------|-----|-----|
| | ♂ | ♂ | ♀ | ♀ |
| Sex..... | ♂ | ♂ | ♀ | ♀ |
| | mm. | mm. | mm. | mm. |
| Total length..... | 110 | 115 | 120 | 130 |
| Length of body, dorsal..... | 40 | 40 | 45 | 46 |
| Length of body, ventral..... | 38 | 37 | 41 | 43 |
| Tip of body to base of dorsal arms..... | 54 | 52 | 61 | 60 |
| Width of fin at widest point..... | 14 | 17 | 17 | 18 |
| Length of fin..... | 23 | 24 | 30 | 30 |
| Width across fins..... | 33 | 37 | 38 | 42 |
| Width of body..... | 13 | 18 | 18 | 18 |
| Depth of body..... | 12 | 13 | 13 | 15 |
| Width of head across eyes..... | 15 | 12 | 11 | 14 |
| Length of head (nuchal cartilage to base of dorsal arms)..... | 13 | 12 | 15 | 15 |
| Length of funnel, median..... | 9 | 9 | 8 | 10 |
| Length of right dorsal arm..... | 21 | 29 | 28 | 26 |
| Length of left dorsal arm..... | 23 | 30 | 28 | 26 |
| Length of right second arm..... | 25 | 35 | 33 | 31 |
| Length of left second arm..... | 27 | 34 | 33 | 30 |
| Length of right third arm..... | 24 | 33 | 31 | 31 |
| Length of left third arm..... | 25 | 32 | 32 | 28 |
| Length of right ventral arm..... | 29 | 32 | 32 | 29 |
| Length of left ventral arm..... | 29 | 32 | 32 | 29 |
| Length of right tentacle..... | 54 | 62 | 62 | 68 |
| Length of right tentacle club..... | 9 | 9 | 11 | 11 |
| Length of left tentacle..... | 55 | 63 | 59 | 69 |
| Length of left tentacle club..... | 10 | 9 | 9.5 | 11 |
| Length of hectocotylized part of left ventral arm (taken from last hook to tip)..... | 8 | 10 | — | — |

The male shows a large spermatophore bundle in process of extrusion from Needham's sac and it may be added that the same observation is true of the male from Messina.

Upon writing to Senhor de Noronha and to Senhor Adão d'Abreu Nunes, to whom, I believe, belongs the credit for the actual capture of the specimens, these gentlemen courteously responded with notes of so great intrinsic interest that it seems desirable by means of a somewhat free translation to publish them in full, the more especially as direct observations on the luminosity of cephalopods in life under natural conditions are still of exceeding rarity.

The following excerpt is in free translation from a letter from Sr. de Noronha under date of November 13, 1921.

"In reading my notes, I find that the cephalopod was captured by a friend, a great fish enthusiast, toward midnight of the 19th of June, 1917, at the surface of the sea and in the artificial harbor of Pontinha, to the west of Funchal.

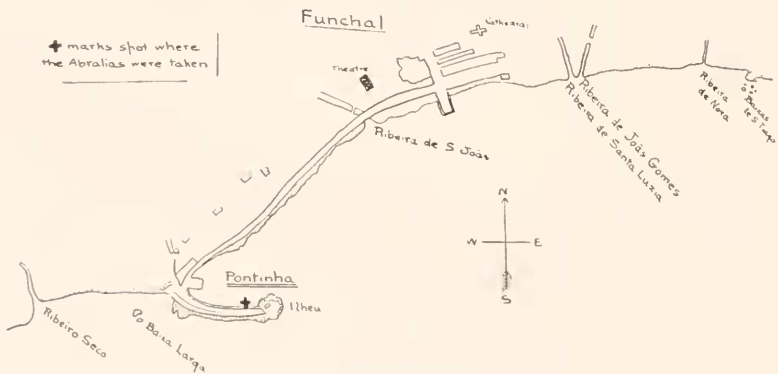


FIG. 1. Sketch map of the Bay of Funchal. The point of capture of the specimens of *Abralia veranyi* mentioned in the text is marked by a +.

"I was there on the quay myself that selfsame evening, and I was very happily able to record that the animal was luminous, the light being very vivid and of a lovely ultramarine blue. One saw 5 lights ('foyers'), disposed in an arc around the eye and on the lower region of this organ, 2 of these photophores being larger and 3 smaller. On the body, the head, and the arms there were many similar lights, which were more numerous on the ventral side. I also noticed that out of the water the animal was still very lively and tried to bite in its anger.

"From the jetty was perceived from time to time an indi-

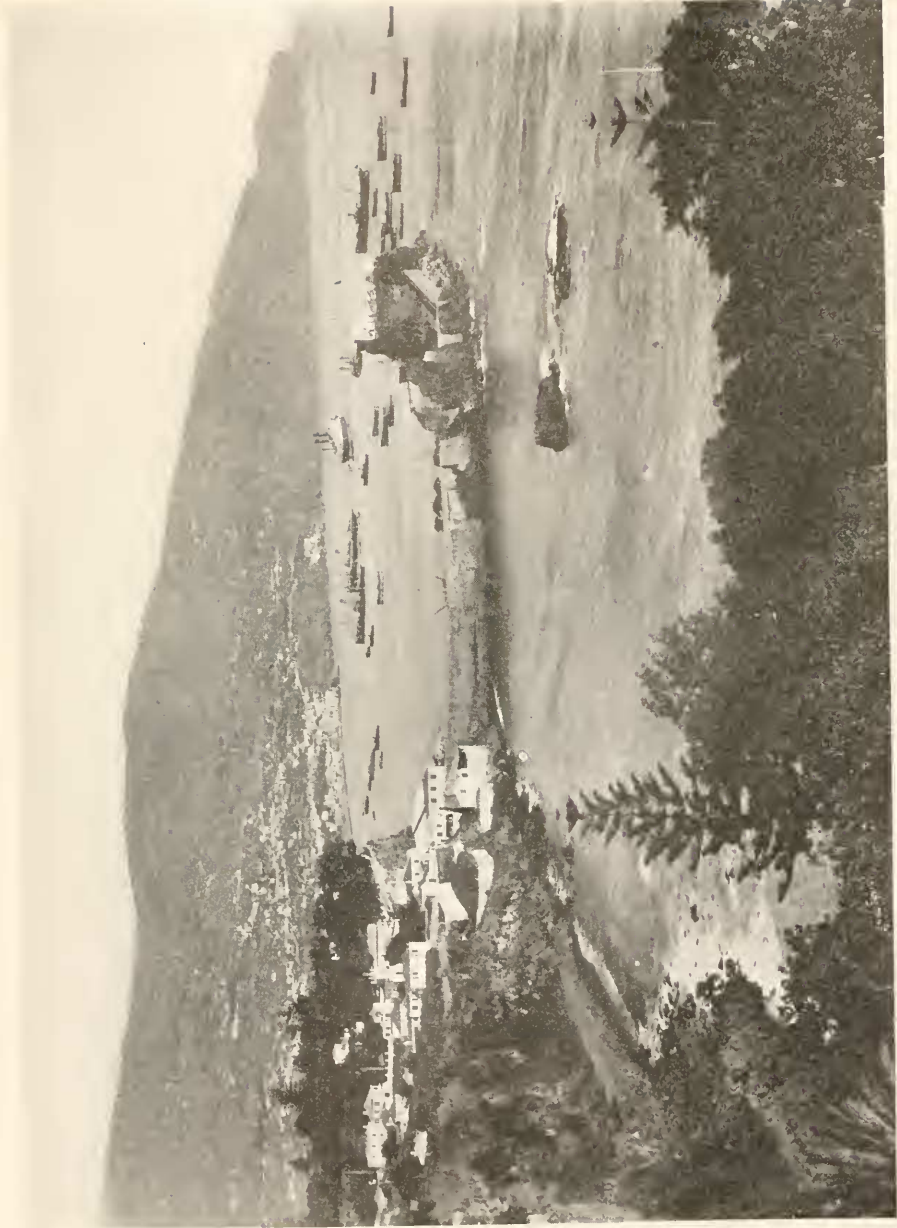


FIG. 2. The Bay of Funchal and harbor of Ponta da Formosa viewed from the west. (Photograph by M. O. Perestrello & F. Os
Madeira.)

vidual which swam rapidly near the surface, giving out its phosphorescence, and then my friend from the top of the wall dexterously manipulated his long-handled 'peneiro' (dip-net). I obtained in this manner a dozen examples, and I could have had many more if I had had need of them. It was an evening warm and calm, and it seems to me that it is for this fine weather that the *Abralia* shows preference. At least it is in summer and autumn that the charming cephalopod arrives near the walls of the harbor of Pontinha. This locality is very sheltered, almost closed to currents and winds, and it is perhaps this circumstance which draws it to this nook of the shore, attracted furthermore by the lamp which illumines the quay. Indeed, as I believe, this cephalopod has never been seen in the five less protected places on the south coast of Madeira, where, during the night, they drag the fish seines, and where it would be easy to capture them if they were there. I myself have investigated these places, but I have seen taken in the nets only the common cephalopods of Madeira: a *Loligo*, a *Sepia*, and a *Polypus*.

"I would also broach the opinion that the *Abralia veranyi* is an abyssal species which at night in summer migrates vertically and horizontally to attain the shore line, and by day betakes itself anew to the depths of the ocean."

Under date of February 1, 1922, Sr. Nunes wrote me further:

"The cephalopod in question has been captured by myself in the sheltered quay of this city of Funchal, called the Quay of Pontinha, during the months of July, August, and September.—Almost every year one may capture them in this harbor during the night where they approach the steps of debarcation, following the lighting of the electric lamps of the above-mentioned steps. With a certain alacrity one may catch them with the aid of a little wire basket, because these animals come almost to the surface of the water, being distinguishable by the brilliancy ('*éclat*') of a bluish phosphorescence which they cause to gleam from their eyes."

From these notes it would appear that the phenomena described are distinctly seasonal in character. This fact, the exceeding vigor and activity evinced by the animals when captured, and

finally my own observations on the physiological condition of both males and females, affords convincing evidence that the inshore nocturnal migration of the Madeiran *Abralia* is essentially of reproductive significance and has to do with either the mating or the spawning, or very possibly indeed with both. Such a conclusion finds the strongest possible confirmation in the detailed observations of Ishikawa ('13) and Sasaki ('14) on a somewhat nearly allied species of squid, *Watasenia scintillans*, the famous Firefly Squid ("Hotaru-ika") of Japan. The parallel extends to still further particulars, but so little information of consequence concerning the habits and life histories of the smaller squids has accumulated that the Japanese observations are almost the only ones of any relevance to be found in the literature. Like the *Abralia*, *Watasenia* "is a deep-sea animal, living during the day in a depth of 100 or more fathoms, and when the night is at hand, they approach to the coast, and after sunset they lay the eggs, and as soon as they finish their spawning, go back to the deep sea" (Sasaki, '14, p. 95). After the fixation of the spermatophores in the nape of the female (in quite a different position, as it would appear, from what is to be observed in *Abralia veranyi*), the male *Watasenia* is thought to perish. The season of this extraordinary migration varies somewhat in different parts of the Japanese Empire, but in Toyama Bay on the west coast it is late April and May. Here the firefly squid comes inshore in such enormous numbers that their fishery is a considerable industry, the total catch being given by Sasaki as 1,000 tons. Due to the disappearance of mated males, nearly the entire catch seems to be comprised of females (one count given is 1 ♂ to 79 ♀ ♀). No juvenals are found with them, and only a small per cent. of those taken were found to have food in the stomach. A net drawn up at 9 or 10 P.M. is said to be better filled than one hauled in at 3 or 4 A.M., a circumstance which Sasaki suggests may be largely due to the fact that the schools swim in from the deep when sunset approaches, lay their eggs towards evening, and become entrapped in the nets on their way back. The fact that the *Abralia* is to be seen soon after the lights on the quay are illuminated may indicate that something of a nearly similar nature goes on here.

Sr. de Noronha's allusion to the enraged state of the animal

when captured is curiously in accord with the behaviour of *Watasenia* at the height of its own (spring) migration, at which time Sasaki states that "they attacked us violently, biting our hands with their jaws." Such as the Japanese catch in late summer or autumn, on the other hand, are quiet and show little vitality.

From the relative emphasis laid upon the sources of the animal's illumination by both Madeiran observers, but especially by Nunes, it would seem that the ocular photophores of this *Abralia* irradiate a conspicuously brighter light than the more abundant organs of the body surface. This is very much what one would superficially expect from the general appearance of these organs in the dead animal. Turning again to the Japanese species we find that Ishikawa ('13, p. 168) likewise states that of the three types of photophores found in *Watasenia scintillans*, at least two of which are entirely homologous with those of *Abralia veranyi*, the organs of the outer integument come last in the intensity of their light. Yet it must be remembered further that Sasaki, working more extendedly on the same species, was unable to make out any difference between the light of the ocular and that of the integumentary photophores. However this may be, the function of light production in both species would seem to be essentially the same. The brilliance of the display stressed by both Madeiran and Japanese observers, coinciding as it does in each case with the schooling habit, the nocturnal migration, and the period of sexual activity, is most readily interpreted as a mating phenomenon, at least in very large part. I do not mean by this that the sexes actually recognize one another's different nature by means of corresponding differences in the luminosity of male and female, although at the same time the possibility of such recognition should not be too quickly excluded from consideration merely because Sasaki, who inquired into this aspect of the question quite particularly, found himself entirely unable to distinguish the sexes merely by the light of the animals at night. For there is another important way in which the photogenic function could serve an animal behaving as *Abralia veranyi* does during the reproductive season, and that is by simply furnishing a visual method by which the schools can assemble or keep together

during the vicissitudes of migration. If this be supplemented either by slight visible sex differences, or by some chemical or other means of inter-attraction, such an arrangement might be sufficiently adequate to insure the maintenance of the species. Further field observations with this point in mind would doubtless yield some valuable and entertaining information.

At first thought it seems passing strange that so conspicuous a phenomenon has not been observed more commonly. However, for the occurrence of species possessing such habits at stations convenient for observation near the shore there would seem to be required not alone shelter from heavy waves but an abrupt slope from the shore-line to the 100-fathom mark so that the contingent requirement for lateral migration be not too great, or similarly a near approach on the part of the deeper regions of the sea either by the agency of a submerged valley or some other considerable depression. Such conditions are perhaps not always found in appropriate combination in the regions inhabited by these species. Whatever the said conditions may be, Funchal evidently satisfies them, and so affords nearly ideal opportunity for the study of *Abralia veranyi*. It is hoped that possibly this will prove by no means the only enoploteuthid squid to be found there.

Whether the animal occurs in the near neighborhood of Madeira at all seasons of the year, or whether its nightly appearance in summer is but the visible culmination of a more extended series of migrations from much farther afield, is a final interesting problem which must be left for some future deep-sea expedition to solve.

Acknowledgment is due to Senhores M. O. Perestrello & Fos. of Madeira for the use of the accompanying photograph, and to Sr. de Noronha for the original of the small sketch map appended. A grant from the Rumford Committee has also been a contributing factor in the preparation of this report.

SUMMARY.

1. *Abralia veranyi* (Rüppell) is a somewhat rarely captured Mediterranean cephalopod, possessing interesting luminous qualities due to the presence of numerous and exceedingly complicated photogenic organs.

2. It is here reported from the Bay of Funchal, Madeira, this constituting, it is believed, the first record of the species from the open Atlantic.

3. The specimens appear to differ in only very minor respects if at all from those of Mediterranean origin.

4. The species comes into the shallow water of the harbor at night during the summer months, supposedly for the purpose of mating, spawning, or both.

5. Owing to their comparative abundance at this time of year and the ease with which they may be observed and captured, Funchal is evidently an unusually favorable locality for the study of the light production or general bionomics of this interesting little squid.

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